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Moving beyond averages
uncertainty and variability
analysis in industrial ecology



**UNIVERSITY OF
CAMBRIDGE**

Special Session
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Communicating evidence

Need to communicate

- ★ Likelihood / probability
- ★ Confidence / agreement level
- ★ Impact / severity

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Table 1. Likelihood Scale

Term*	Likelihood of the Outcome
<i>Virtually certain</i>	99-100% probability
<i>Very likely</i>	90-100% probability
<i>Likely</i>	66-100% probability
<i>About as likely as not</i>	33 to 66% probability
<i>Unlikely</i>	0-33% probability
<i>Very unlikely</i>	0-10% probability
<i>Exceptionally unlikely</i>	0-1% probability

Confidence Levels

Very low

Low

Medium

High

Very high

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Very likely,
with high agreement,
to see medium confusion!

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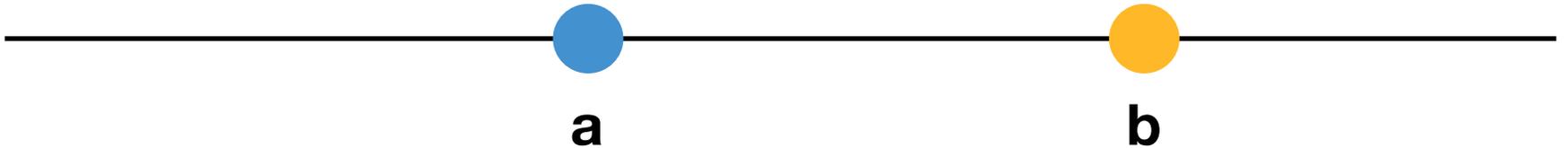
“even where the knowledge provided by science is overwhelming, people often resist it – sometimes outright deny it” Gwande (2016)



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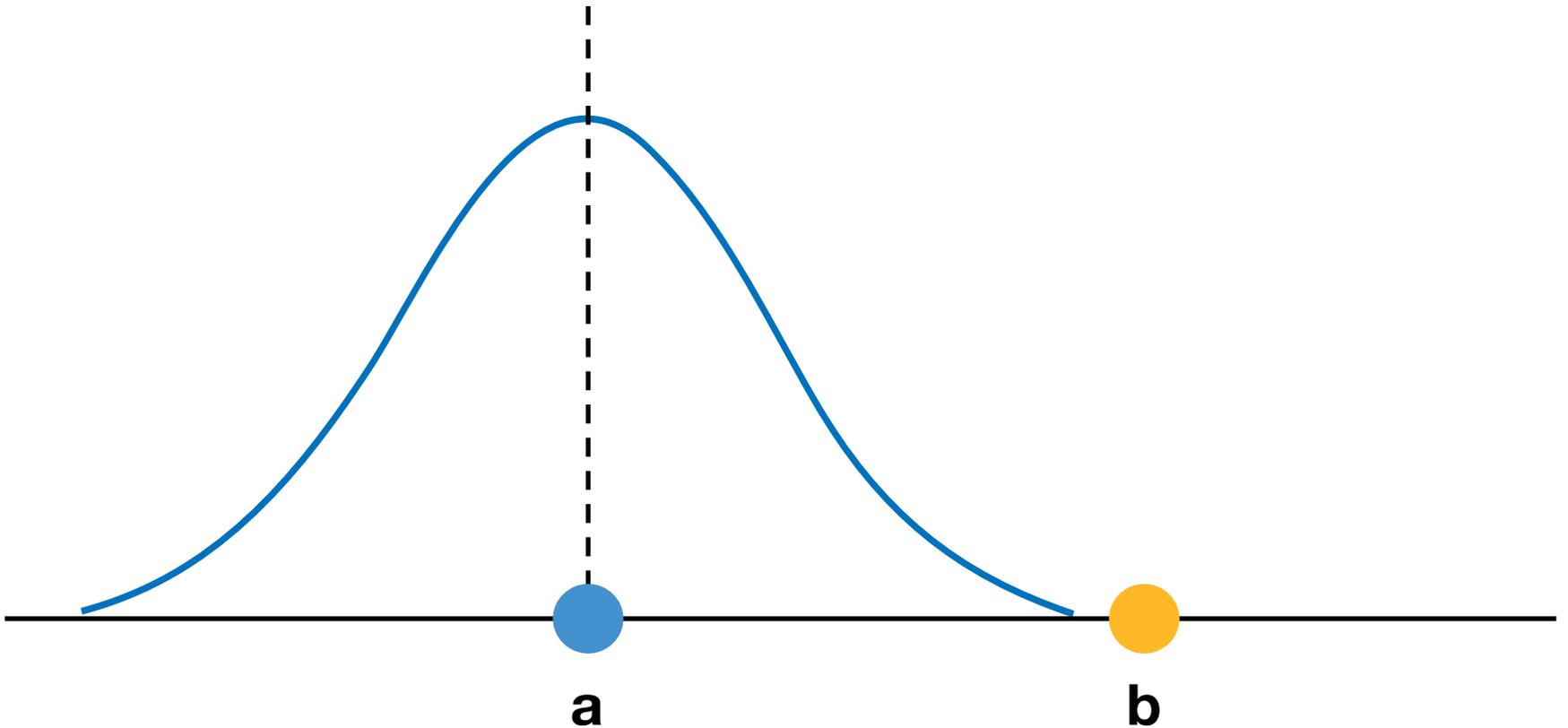
Uncertainty and variability

Is $a < b$?



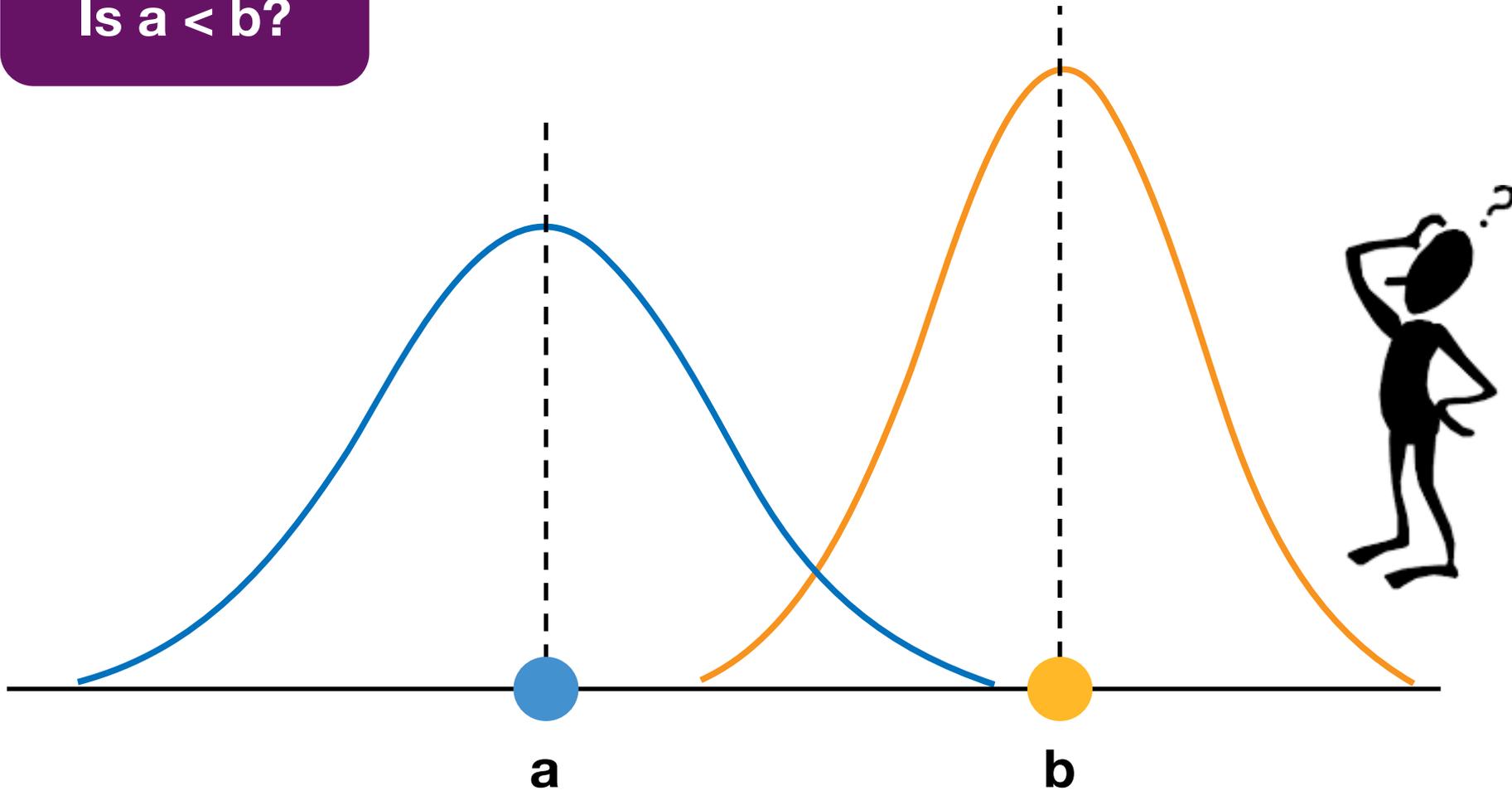
Uncertainty and variability

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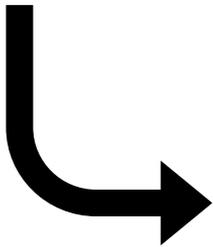
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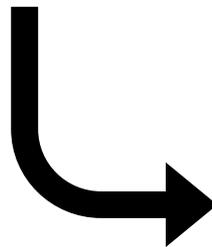


Process of uncertainty analysis

1 Data quality assessment and uncertainty characterization



2 Uncertainty propagation and inference



3 Visualisation and interpretation of uncertainty

Uncertainty and variability

Sources of uncertainty

Statistical variation

Variability

Inherent randomness and unpredictability

Subjective judgment

Disagreement

Linguistic imprecision

Approximation

Theories and Tools

Information theory

Frequentist / Bayesian statistics

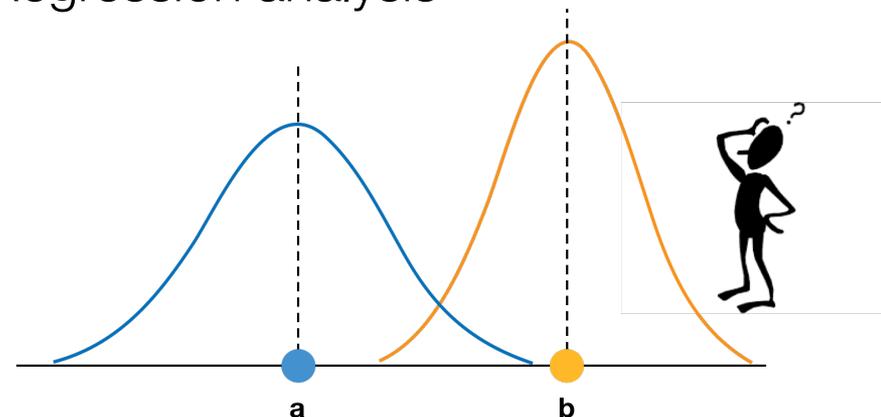
Fuzzy set theory

Analytical error propagation

Monte Carlo simulation

Markov Chains

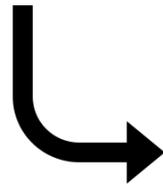
Regression analysis



Group brainstorming exercise

★ 3 boards

1 Data quality assessment and uncertainty characterisation



2 Uncertainty propagation and inference



3 Evaluation and communication of uncertain results

★ 3 colours



Special Session Agenda

10+10
mins

Data quality assessment and uncertainty characterisation
David Laner | TU Wien | david.laner@tuwien.ac.at

10+10
mins

Uncertainty propagation and inference
Rick Lupton | Uni of Cambridge | rcl33@cam.ac.uk

10+10
mins

Visualisation and interpretation of uncertainty
Leo Paoli | Uni of Cambridge | lp457@cam.ac.uk

10
mins

Going forward
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